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A Study of Construction Machinery Noise Levels at Los Alamos National Laboratory

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Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

A STUDY OF CONSTRUCTION MACHINERY NOISE LEVEL AT LOS ALAMOS NATIONAL LABORATORY

by

Jacob L. Knight and Steven S. Vrooman

I. INTRODUCTION

Los Alamos National Laboratory (LANL), which has been operated for the Department of Energy by the University of California since 1943, is located 35 miles northwest of Santa Fe, New Mexico, at the base of the Jemez Mountains. Los Alamos was established for the purpose of constructing the world's first atomic weapon, and its isolation played a major role in its selection. Today, the mission of LANL is not only national security but also to perform "cutting edge" science ranging from biological research, such as the Human Genome Project, to astronomical and mathematical research and many other scientific or technical fields.

LANL consists of 43 square miles of developed and undeveloped land that is host to a large mixture of plant and animal communities across an area that varies in elevation and topography, thus creating unique and diverse habitats rich in natural resources. Many animal species have taken advantage of the habitats offered at LANL and surrounding undeveloped areas. Some species are listed as threatened or endangered, and therefore require special protection. Some of the threatened or endangered species occurring on LANL property and surrounding areas are the Mexican spotted owl (threatened), the bald eagle (threatened), and the southwestern willow flycatcher (endangered).

The Threatened and Endangered Species Habitat Management Plan (HMP) was created by the Ecology Group (ESH-20) at LANL as a result of the need to manage the Laboratory's natural resources more proactively rather than reactively as in the past. The HMP is an essential tool used not only to help with the protection and improvement of threatened and endangered species' habitat, but also to help facilitate the review of construction and other projects in accordance with important environmental laws such as the Endangered Species Act of 1973 and the National Environmental Policy Act. Every project proposed by LANL is reviewed under the HMP because of unique circumstances and varying habitat present at each location (LANL 1998).

As part of the HMP, specific areas of threatened or endangered species' habitat, or potential habitat, were outlined and noted as Areas of Environmental Interest (AEIs). Each AEI is made up of a core area and a buffer area, with the core having the highest potential for species breeding and/or wintering. Noise production at or near any AEI is of particular concern because it is a significant source of habitat disturbance and therefore must be managed appropriately (LANL 1998).

This study consists of sound levels of various types of machinery operated during projects on LANL property. In order to facilitate the project review and management process, a database of sound levels of various types of construction machinery and projects is needed as a point of reference. In the future, comparisons of projects with similar types of machinery to those previously measured will be possible, and the necessary regulatory reviews can be completed in a more timely, efficient, and scientifically defensible manner.

II. METHODS

Sound is actually a pressure fluctuation detectable by the human ear and translated to the brain as an electrical impulse. Sound pressure level is expressed in decibels (dB), the scale used to measure and compare the loudness of sound. For instance, 0 dB represents the threshold of hearing, which is 3×10^{-9} psi (Bell et al. 1982). The scale is often "weighted," meaning it is manipulated for the purpose of comparing response. The most common weighting scales are A and C, where A imitates the response of the human ear. The C scale is used as a baseline and is most often used to measure low frequency sound (Bell et al. 1982). According to the HMP, artificially increased noise levels at the AEI core-buffer boundary that are greater than 6 A-weighted decibels above average background levels are considered a potential impact.

Sound measurements were taken using a Quest Technologies Model 2900 Integrating and Logging Sound Level Meter mounted on a four-foot tripod. This model is capable of measuring sound levels within a range of 60 dB. Most measurements were taken within 50 – 110 dB or 40 – 100 dB. The sound level meter operates by taking a measurement at a specific point in time and logging it in its internal memory, which can later be downloaded into a PC using Quest software. The machine can be programmed for various logging intervals. A one-second logging interval was used in order to better capture any variation of sound level during the approximate five-minute period. Had a 10-second logging interval been used, only one data point would have been logged for 10 seconds of noise production. Longer time period logging intervals are often used when memory space needs to be saved for longer studies.

The unit is also capable of measuring numerous sound level quantities. Quantities measured for this study were LEQ, LMAX, LMIN, LPEAK, and LN. Following is a brief definition of these quantities: LEQ – the average integrated sound level; LMAX – the maximum sound level during a study, i.e., during the time the meter is running; LMIN – the minimum sound level during a study; LPK – the peak level during a study recorded by a second peak detector. LPK represents an instantaneous measurement, as opposed to LMAX which is averaged over the logging rate; LN – the sound pressure level surpassed for N% of the time during a study, 50% values were used for this report. All quantities were measured using the A scale except for LPK which was measured in the C scale.

Assuming that the sound levels of various machinery did not vary significantly over time, approximately five-minute measurements were considered a sufficient representation.
Project site measurements were made by determining where a project was occurring, going to the site, and setting the sound level meter at a known distance from sources of noise production. A Haglof Laser Pro range finder was used to measure distance. A diagram of the surroundings was illustrated, and the types and brand names of most noise producing machinery and the distances from the sound meter of each were recorded in a journal. After an approximate five-minute measurement, the distance was then doubled and the measurement repeated and similar notes and illustrations were recorded. Distances were doubled when possible in order to later project the

attenuation of sound travel by using a mathematical formula which incorporates the dB levels at each known distance.

III. RESULTS

This section contains a detailed report of the sound measurements at each construction site. Hereafter the term "study" will refer to an approximate five-minute sound level measurement at each site. Numeric values for each study will be contained in a table after each site description. Also, a diagram of each site showing locations of equipment during each study is included in Appendix A.

A. Site 1a

These measurements were taken on April 28, 1999, at the Los Alamos Neutron Science Center (LANSCE). Davis & Associates was building a radioactive wastewater treatment lagoon.

Study 1 consists of hammering at 40 feet from the sound level meter. Study 2 consists of hammering at 40 feet and a Bobcat 853 diesel 48 horsepower operating at 100 feet. A skill saw was turned on at the end of the study. Study 3 consists of a Bobcat in operation at 40 to 60 feet, 20 feet was its range of motion, and hammering at 30 feet. Study 4 consists of the Bobcat only at 80 to 100 feet with 10 mph wind at the end of the study.

Table 1. Site 1a Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:05:27	58.5dB(A)	94.7dB(C)	73.8dB(A)	38.3dB(A)	52.0dB(A)
Study 2	0:03:58	64.8dB(A)	101.0dB(C)	79.7dB(A)	56.8dB(A)	62.7dB(A)
Study 3	0:07:40	72.2dB(A)	112.7dB(C)	84.4dB(A)	60.7dB(A)	70.1dB(A)
Study 4	0:06:09	68.1dB(A)	102.9dB(C)	79.6dB(A)	60.3dB(A)	67.0dB(A)

B. Site 2

On April 29, 1999, sound measurements were taken at Technical Area (TA) 33. A segmented gate system (SGS) was set up in an area with contaminated soil. This project was headed by Environmental Restoration (ER). The SGS sifts material according to size then screens for radiation. If radiation is found the material is sent through a "hot shoot" and transported to Area G for proper disposal. Two front-end loaders were used; one to load potentially contaminated soil into the SGS and one to return non-contaminated soil back to the landscape. The SGS was powered by a large generator.

Study 1 measured the Onan Genset 400 KW generator noise at 29 feet. Study 2 measured the generator at 58 feet. Study 3 measured the SGS at 40 feet for the first two minutes then a Volvo L90C front-end loader as well for the remaining time at 50 to 60 feet. Study 4 was taken at 80 feet from the SGS. Study 5 was a brief measurement taken 40 feet from where the Volvo L120C was replacing non-contaminated soil about 100 meters from the SGS. Study 6 also measured noise levels of the L120C at the same location as study 5, they were brief because the operator was in and out of the study location frequently. Study 7 was taken 57 to 60 feet from the L120C, time and space was limited once again.

Table 2. Site 2 Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:08:00	81.9dB(A)	106.3dB(C)	84.0dB(A)	79.8dB(A)	81.9dB(A)
Study 2	0:05:11	75.7dB(A)	103.2dB(C)	79.8dB(A)	73.7dB(A)	75.6dB(A)
Study 3	0:05:56	77.2dB(A)	113.6dB(C)	93.5dB(A)	72.6dB(A)	76.2dB(A)
Study 4	0:05:46	72.7dB(A)	112.7dB(C)	88.8dB(A)	65.6dB(A)	70.2dB(A)
Study 5	0:01:07	67.4dB(A)	103.7dB(C)	85.4dB(A)	53.6dB(A)	62.6dB(A)
Study 6	0:00:30	63.0dB(A)	112.4dB(C)	74.2dB(A)	53.6dB(A)	59.8dB(A)
Study 7	0:00:52	63.0dB(A)	110.0dB(C)	74.7dB(A)	54.2dB(A)	61.3dB(A)

C. Site 1b

On May 5, 1999, sound measurements were taken a second time at LANSCE. In operation were a CAT back hoe 416C Turbo 4 x 4, a White Wester water truck, and two soil compactors (or jumping jacks).

Study 1 consists of the back hoe at 40 feet, which started moving two minutes into the study, and the water truck at 42 feet, which was the main source of noise. Study 2 consists of the water truck at 84 feet, the two dirt compactors at 60 feet, and the back hoe at 65 feet.

Table 3. Site 1b Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:10:39	76.7dB(A)	75.7dB(C)	86.8dB(A)	60.2dB(A)	71.1dB(A)
Study 2	0:05:48	77.4dB(A)	77.0dB(C)	86.2dB(A)	71.4dB(A)	77.6dB(A)

D. Site 3a

On May 12, 1999, sound measurements were taken at TA-16, Material Disposal Area (MDA) P. Roy F. Weston, Inc., was working on an ER project that involved a significant amount of contaminant removal from an old high explosives landfill, which has been closed for many years. Many remote machines were used, such as remote cranes. We could not get very close to the heavy construction equipment.

Study 1 consists of a Denyo MQ Power 60 Generator at 20 feet. There was a strong wind during the study. Study 2 is the MQ generator at 10 feet. Study 3 measured the noise produced by another older and louder generator, an ONAN 30. This study was taken 20 feet from the ONAN. Also, a steam jimmy (a high pressure compressor in which water is forced through a metal compartment with heating coils, generally used for decontamination) was in operation 70 feet away. A dump truck passed 10 feet from the meter at 12:15 p.m. Study 4 measured noise levels of the ONAN at 40 feet.

Table 4. Site 3a Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:04:05	61.2dB(A)	96.0dB(C)	74.8dB(A)	58.9dB(A)	61.0dB(A)
Study 2	0:03:54	67.0dB(A)	94.7dB(C)	69.6dB(A)	65.5dB(A)	66.9dB(A)
Study 3	0:03:47	77.7dB(A)	102.6dB(C)	84.0dB(A)	75.0dB(A)	77.3dB(A)
Study 4	0:04:36	71.4dB(A)	101.9dB(C)	79.4dB(A)	68.2dB(A)	71.3dB(A)

E. Site 4

On May 25, 1999, measurements were taken at TA-15 where tree thinning was taking place as a form of fire hazard mitigation. Trees cut with Stihl 038 chainsaws in one area were hauled away by a John Deere 744E front-end loader to a Morbark model 30/36 wood chipper for chipping, which was quite loud. This project has been coordinated by Pat Valerio, and his help made these measurements possible.

Study 1 measured the wood chipper noise at 55 feet and the front-end loader for two minutes. Study 2 measured the wood chipper noise at 110 feet. Study 3 measured the front-end loader at an alternate location where trees were piled. Study 4 consisted of one chainsaw at 50 feet. Study 5 consisted of a chainsaw at 100 feet and the front-end loader at 180 feet, and four minutes into the study, another chainsaw as well. The chainsaws were using mufflers to reduce noise.

Table 5. Site 4 Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:05:31	81.4dB(A)	147.7dB(C)	94.5dB(A)	73.7dB(A)	80.8dB(A)
Study 2	0:04:58	76.6dB(A)	141.5dB(C)	80.8dB(A)	71.0dB(A)	76.5dB(A)
Study 3	0:01:17	63.4dB(A)	140.9dB(C)	74.6dB(A)	49.8dB(A)	60.0dB(A)
Study 4	0:02:24	71.0dB(A)	136.4dB(C)	79.7dB(A)	55.8dB(A)	67.9dB(A)
Study 5	0:05:29	64.7dB(A)	135.8dB(C)	75.0dB(A)	53.7dB(A)	63.0dB(A)

F. Site 3b

On May 26, 1999, sound measurements were taken a second time at TA-16, MDA-P.

Study 1 consisted of a CASE 821B front-end loader and a dump truck (20 cubic ft rock hauler) at 40 feet. The front-end loader was filling the truck with boulders to be hauled away. Study 2 consisted of a Briggs & Stratton GenPower 10.0 generator at 15 feet. Study 3 measured the GenPower at 30 feet. Study 4 consisted of a Kobelco SK 220LC track loader at 25 feet and the steam jimmy at 30 feet. Study 5 consisted of the steam jimmy at 50 feet.

Table 6. Site 3b Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:01:44	80.7dB(A)	147.7dB(C)	93.2dB(A)	66.5dB(A)	72.4dB(A)
Study 2	0:02:17	81.0dB(A)	142.4dB(C)	82.1dB(A)	79.9dB(A)	81.1dB(A)
Study 3	0:02:11	76.0dB(A)	137.4dB(C)	78.2dB(A)	74.1dB(A)	76.1dB(A)
Study 4	0:06:39	80.7dB(A)	155.4dB(C)	94.3dB(A)	74.9dB(A)	79.7dB(A)
Study 5	0:06:47	75.5dB(A)	145.0dB(C)	83.8dB(A)	73.5dB(A)	75.4dB(A)

G. Site 5

On May 26, 1999, measurements were taken at TA-21, where an in situ vitrification project was taking place. The purpose of this project was to test equipment that caused vitrification of contaminated soil as a form of environmental restoration.

Study 1 measured noise levels of a Komatsu PC200LC track loader at 50 feet, which was uncovering vitrified soil. Study 2 measured the track loader at 100 feet.

Table 7. Site 5 Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:04:14	67.7dB(A)	137.8dB(C)	80.7dB(A)	52.4dB(A)	62.3dB(A)
Study 2	0:04:21	64.9dB(A)	137.0dB(C)	76.9dB(A)	54.2dB(A)	61.7dB(A)

H. Site 6

On June 15, 1999, sound measurements were taken at the Los Alamos County Landfill. A diagram was not made for this study.

Study 1 consists of noise measurements from large dump trucks passing at 30 feet. Approximately 1 minute of the study actually contained sound measurements of the trucks, so the average value should be higher. The following chart is a more applicable depiction of this study. The sound levels of the trucks are shown as peaks.

Study 2 measurements were taken in the main trash deposit area and consist of a front-end loader (brand name unavailable) and a trash truck in the same area, both were moving quite a bit. The sound level meter was 125 feet from the source. Study 3 measured sound levels of a Homatsu WA250 front-end loader at 100 feet. The Homatsu was loading a large truck with dirt. Double distance measurements were not taken at this site because of terrain and spatial complications.

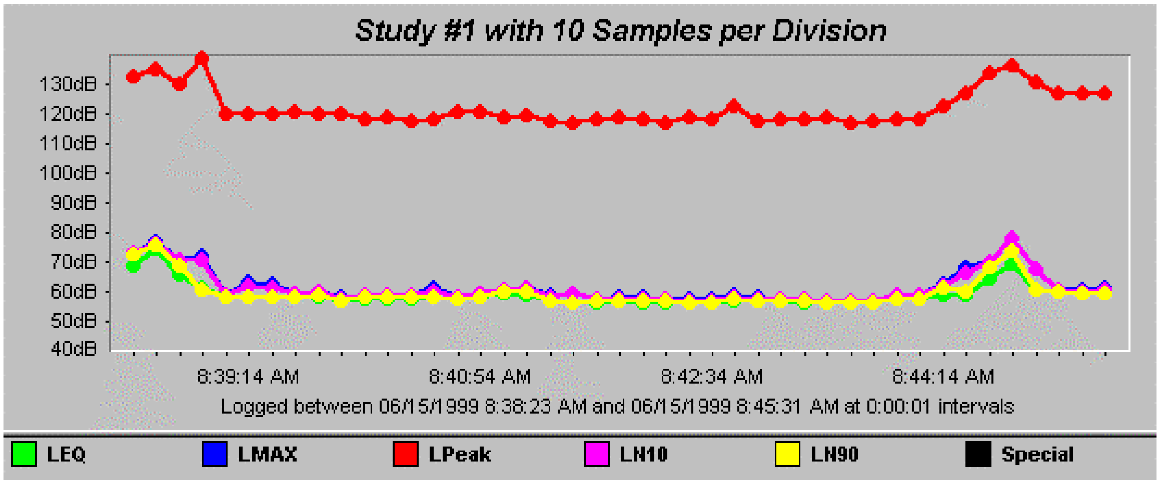


Table 8. Site 6 Study Values

	Run Time	LEQ	Peak	Max	Min	LN50
Study 1	0:07:08	62.1dB(A)	138.4dB(C)	78.1dB(A)	54.8dB(A)	57.3dB(A)
Study 2	0:06:25	68.0dB(A)	142.8dB(C)	87.5dB(A)	55.7dB(A)	58.3dB(A)
Study 3	0:02:27	67.5dB(A)	133.9dB(C)	78.8dB(A)	48.7dB(A)	66.4dB(A)

IV. DISCUSSION

For the purposes of this study, it is important to note that we were only bystanders at the various construction sites and had no control over the movement or operation of any equipment. Therefore, there is variability in the length of time we were able to measure machinery in a consistent manner.

Larry Ross, who was the safety officer at MDA-P, took many sound measurements at his site. He had the operators of the various machinery rev their engines while he took measurements at two different distances from the source. He recorded his results along with diagrams and an overview of the entire site with decibel levels at fairly equidistant locations around the boundary. He gave us copies of all his data and it is shown in Appendix B.

We also conducted a separate study of construction noise at a project site in TA-3 using different sampling methods. The methods and results are given in Appendix C.

The Quest software used for this study compiles graphs for each individual study along with many other numerical values that we did not report because we did not feel it was necessary, the detail is too great. But this information is available if requested.

The noise measurements in this study will help in determining average sound levels of various projects at LANL, but more sound studies should be done in order to establish a much broader database.

V. ACKNOWLEDGMENTS

We would like to thank Todd Haagenstad, Steve Koch, Leslie Hansen, Pat Valerio, Scott Gebhardt, Carey Bare, Larry Ross, and Hector Hinojosa for their assistance with this project.

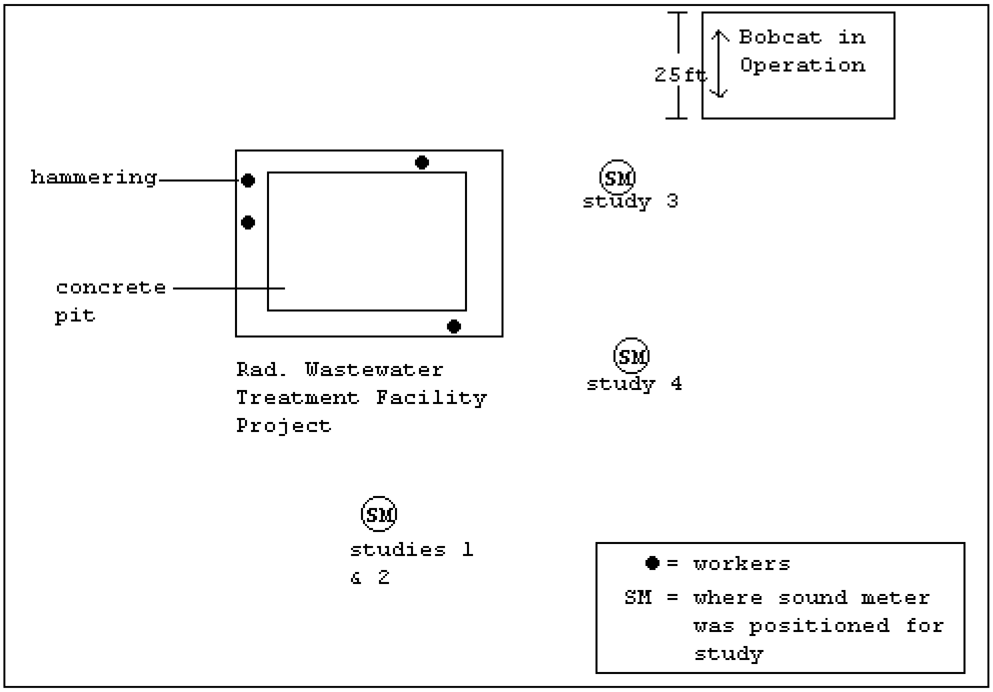
VI. REFERENCES

Bell, L.H., and Associates, “Industrial Noise Control: Fundamentals and Applications,” (Marcel Decker, Inc., New York, 1982).

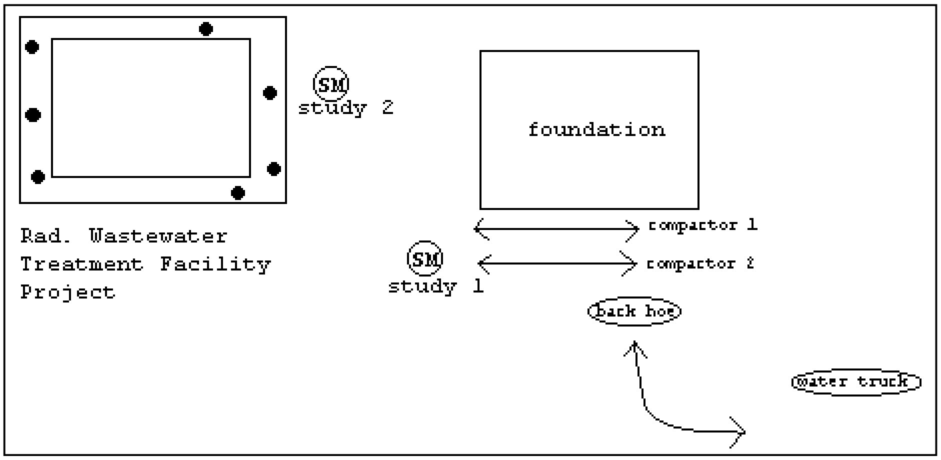
Los Alamos National Laboratory, Ecology Group (ESH-20), “Threatened and Endangered Species Habitat Management Plan Overview,” Los Alamos National Laboratory report LA-LP-98-112 (1998).

APPENDIX A: STUDY DIAGRAMS

Site 1a:



Site 1b:



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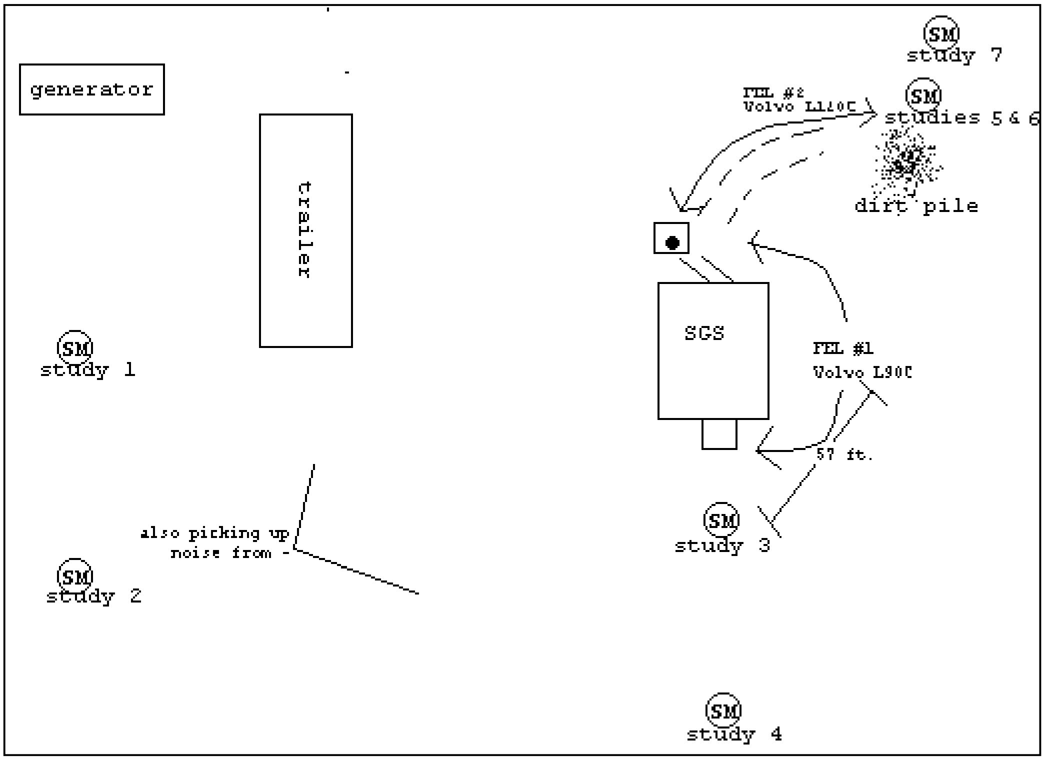
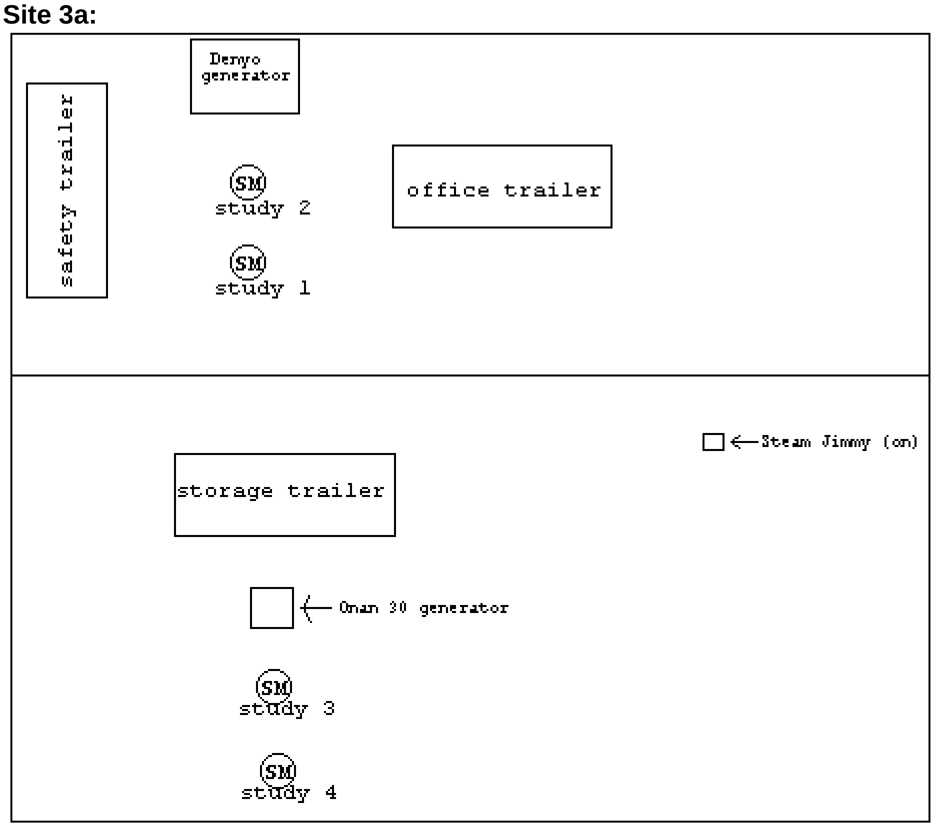
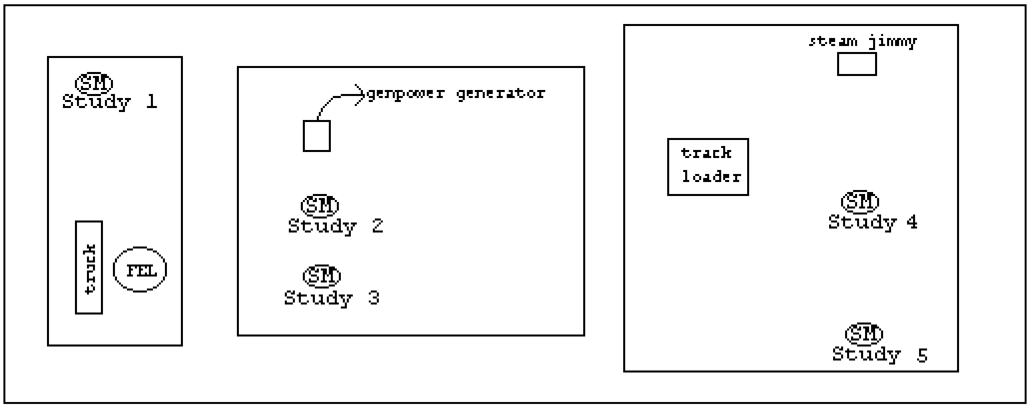


Site 3a:



Site 3b:



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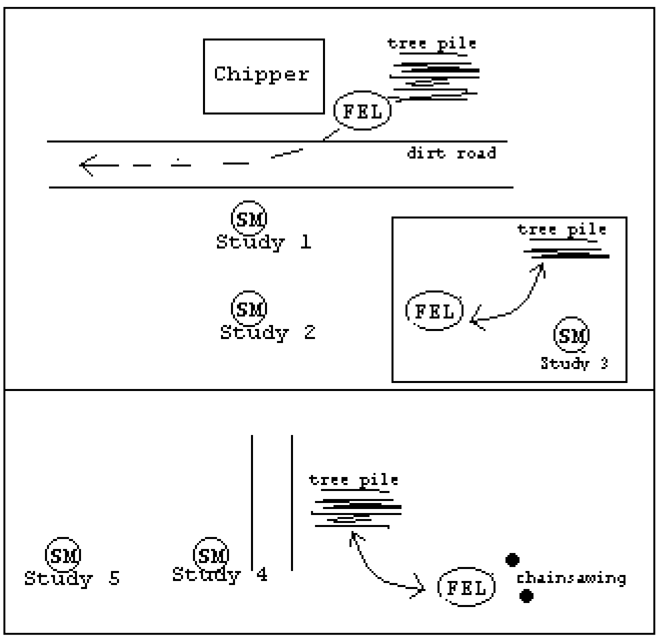

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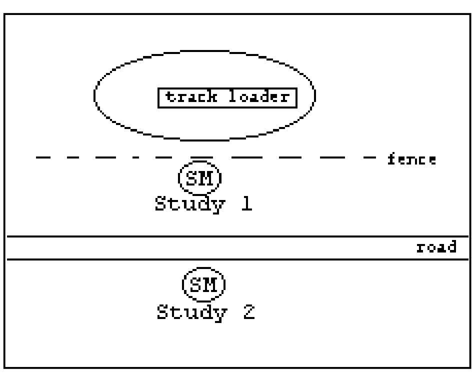


APPENDIX B

February 17, 1999

TO: FILE.

RE: LANL, MDA-P PROJECT BOUNDRY SOUND-LEVEL SURVEY.

FROM: LARRY E. ROSS, MDA-P PROJECT SITE SAFETY OFFICER.

February 16, 1999 a sound level survey was conducted to determine a 66 dBA perimeter along all boundaries of the MDA-P Project. The attached drawing displays results of that survey.

A Simpson Model 884, Type S2A, Sound Level Meter was used to conduct this survey. The Simpson Sound Level Meter was calibrated to 114 dBA prior to the survey and calibration was confirmed following the survey. Calibration was performed using a Simpson Model 887 Calibrator, Serial Number 030876, Calibrated 10/23.98. A foam wind screen was used on the Sound Level Meter mic during the survey.

The weather was clear, sunny, 41 degrees at start of survey , and with 0-3 mph winds.

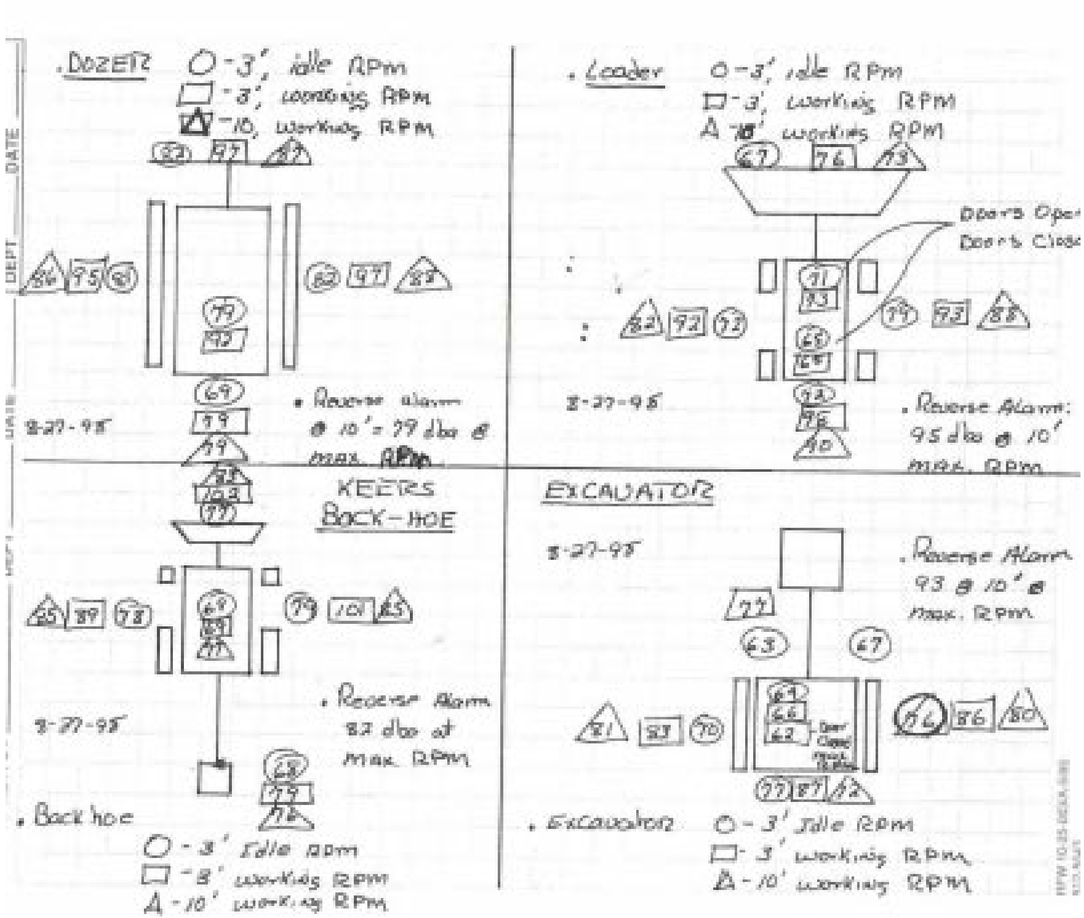
Equipment on-site was operated in areas of the site where that equipment normally operates.

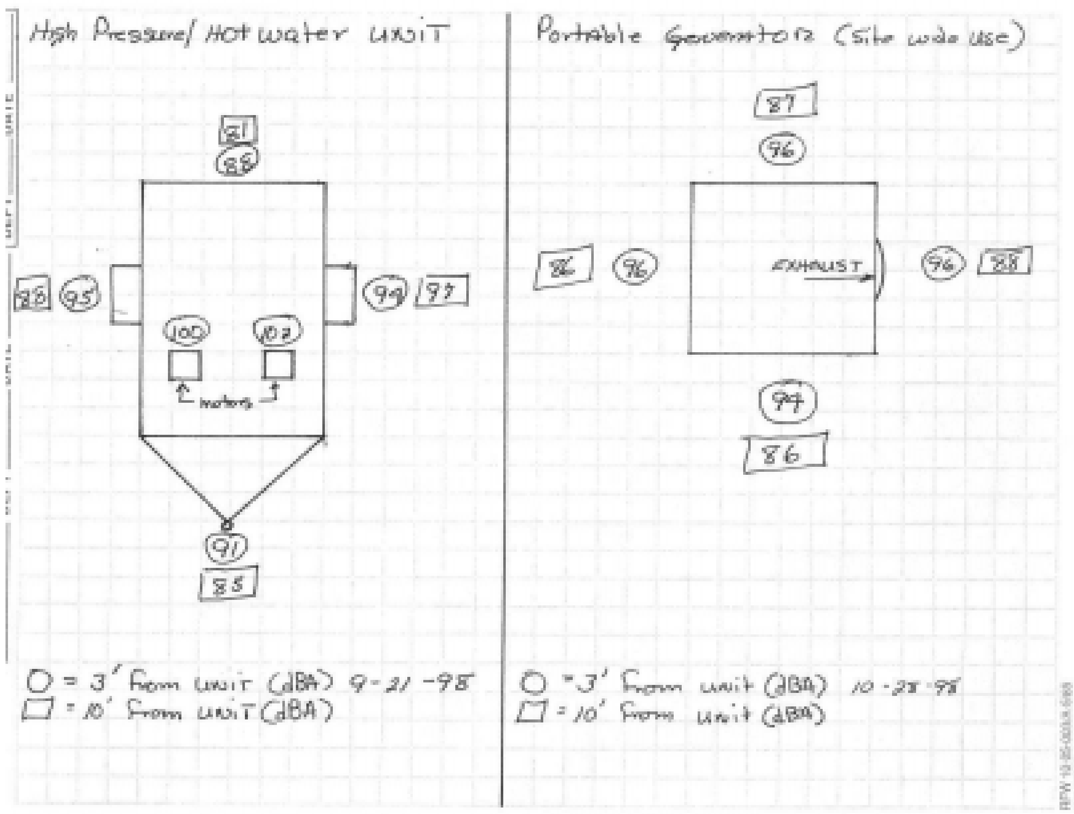
File:
Sound level Surveys
for MOA-P site
Thanks
[illegible]

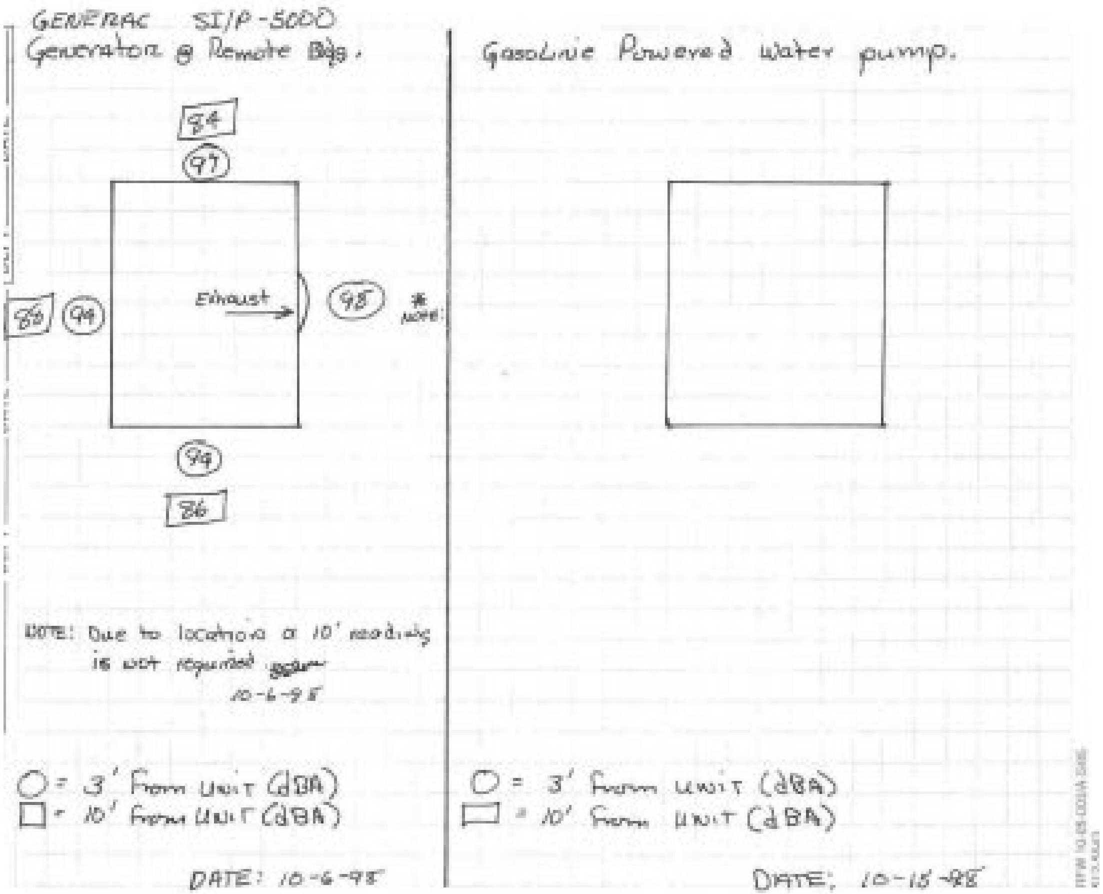
Sound level Survey - Instruments

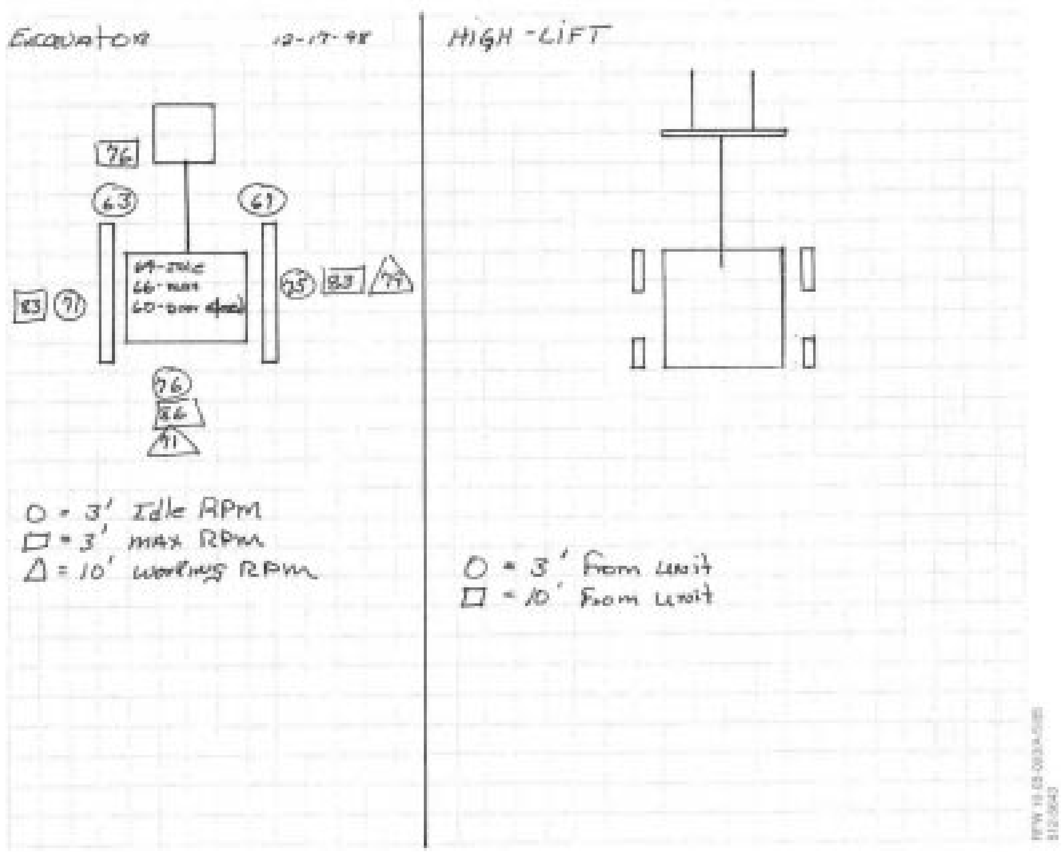
1. Sound Level Meter: - Simpson
- model: 887
- Type S2A
- A Scale (Slow)
- Range 60-120 (130 max)
- Battery Operated

2. Calibrator: - Simpson
- model 890, Ser. No. 030876
- Freq. 1KHz
- Level 114 dB
- Last Calibration 10-23-97 (Simpson Ele

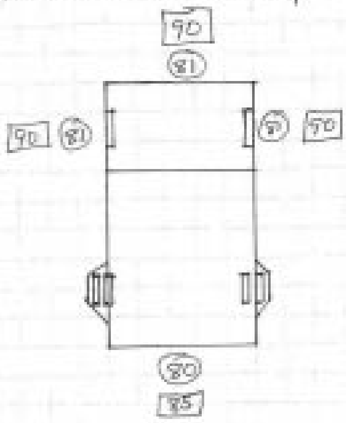

Dozer
O - 3', idle RPM
□ - 3', working RPM
△ - 10', working RPM
8-27-98
Reverse alarm @ 10' = 79 dba @ max. RPM
Loader
O - 3', idle RPM
□ - 3', working RPM
△ - 10' working RPM
Doors Open
Doors Closed
8-27-98
Reverse Alarm: 95 dba @ 10' max. RPM
KEERS BACK-HOE
8-27-98
Reverse Alarm 82 dba at max RPM
Back hoe
O - 3' Idle RPM
□ - 3' working RPM
△ - 10' working RPM
EXCAVATOR
8-27-98
Reverse Alarm 93 @ 10' @ max. RPM
Excavator
O - 3' Idle RPM
□ - 3' working RPM
△ - 10' working RPM


High Pressure/ Hot water unit
motors
O = 3' from unit (dBA) 9-21-98
□ = 10' from unit (dBA)
Portable Generator (site wide use)
EXHAUST
O = 3' from unit (dBA) 10-28-98
□ = 10' from unit (dBA)


GENERAC SI/P-5000
Generator @ Remote Bldg.
84
97
Exhaust
98
* NOTE:
86
94
94
86
NOTE: Due to location a 10' reading is not required
10-6-98
○ = 3' From unit (dBA)
□ = 10' From UNIT (dBA)
DATE: 10-6-98
Gasoline Powered water pump.
○ = 3' from unit (dBA)
□ = 10' from unit (dBA)
DATE: 10-15-98


Excavator
12-17-98
76
63
67
83
71
95
83
79
76
86
71
○ = 3' Idle RPM
□ = 3' MAX RPM
△ = 10' working RPM
HIGH-LIFT
○ = 3' from unit
□ = 10' from unit

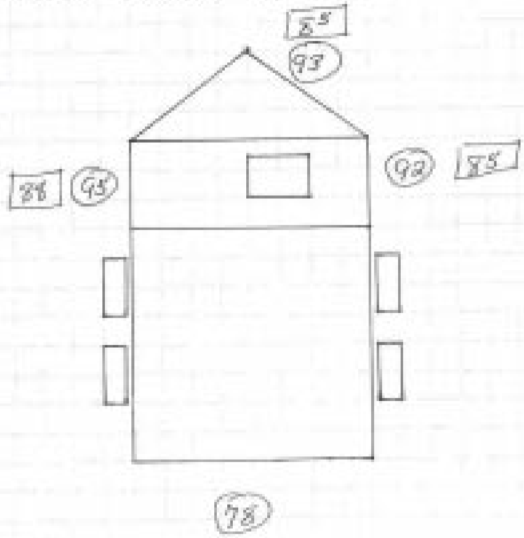
KEERS DUAL Pickup



O = 3' @ idle
□ = 3' @ operating RPM.

1-26-99

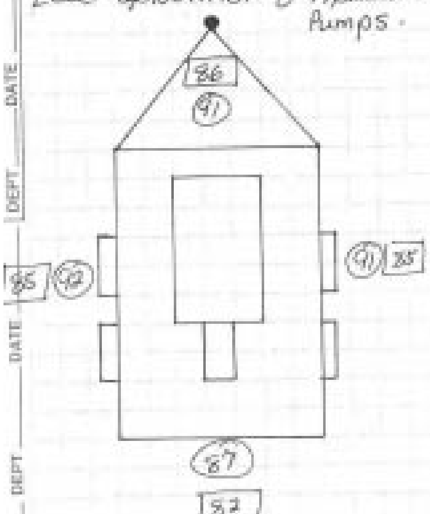
KEERS Water Trailer



O = 3' from motor
□ = 10' from motor

1-26-99

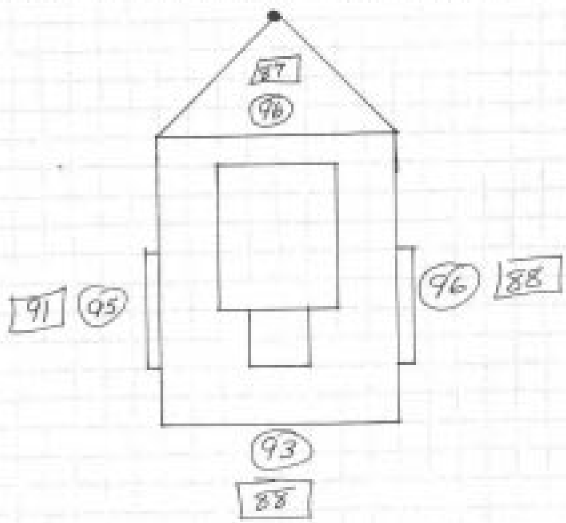
ELEC Generator @ Hydraulic Pumps.



O = 3' @ idle
□ = 10' @ idle

1-26-99

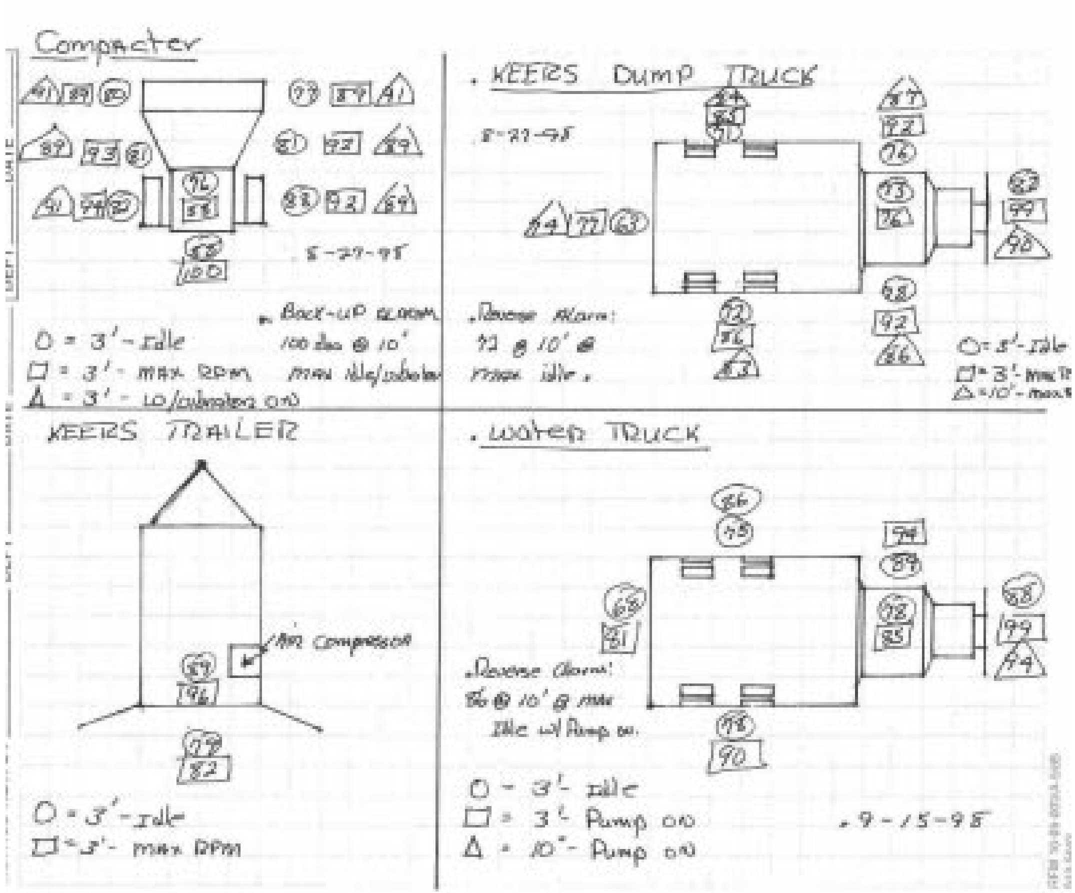
Electric Generator @ DECON AREA

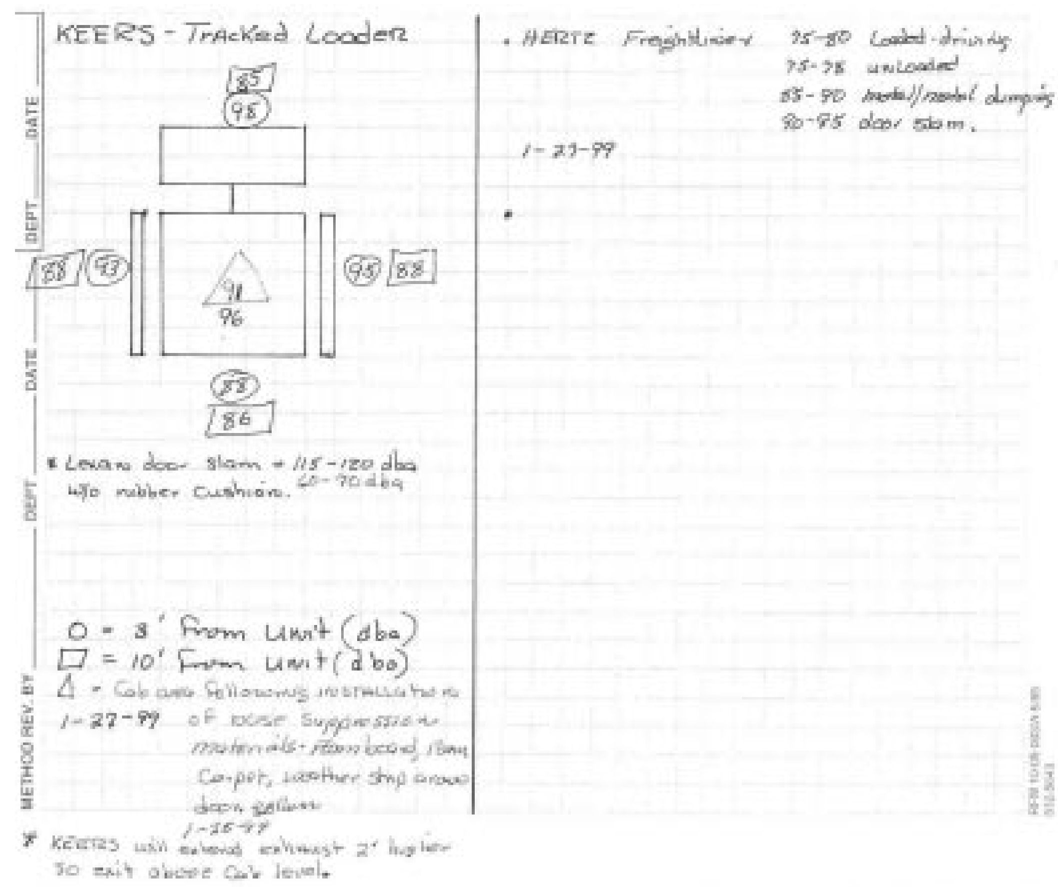


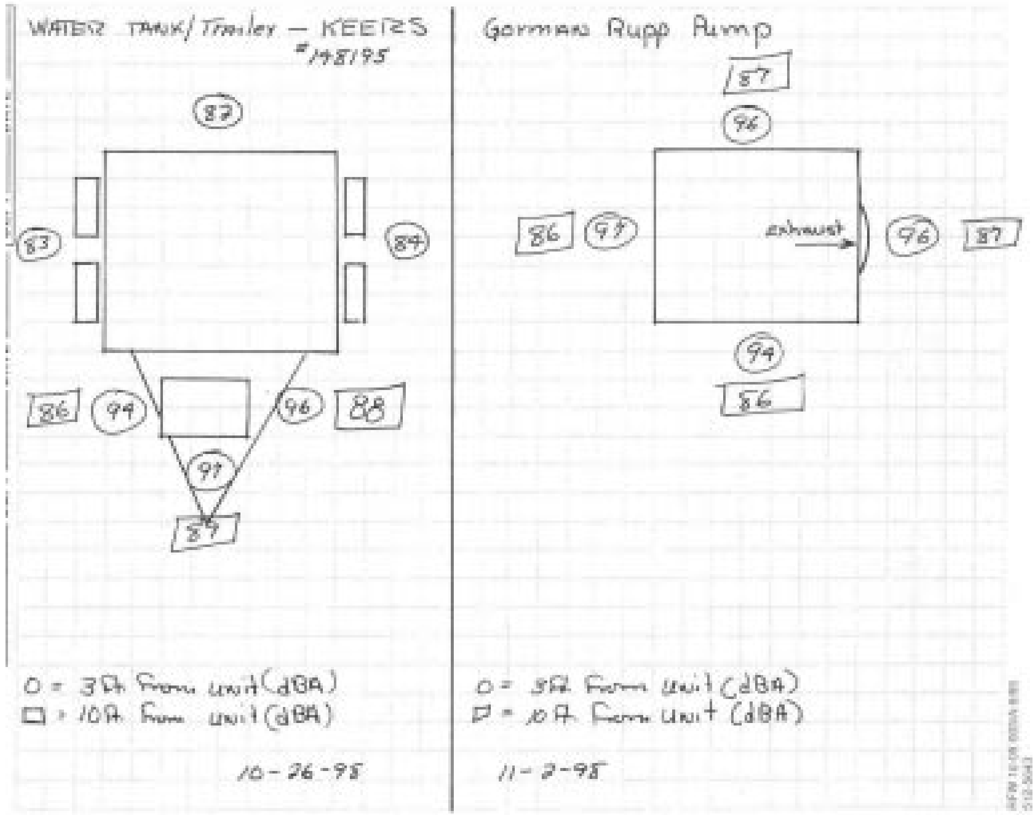
O = 3' from motor @ idle
□ = 10' from motor @ idle

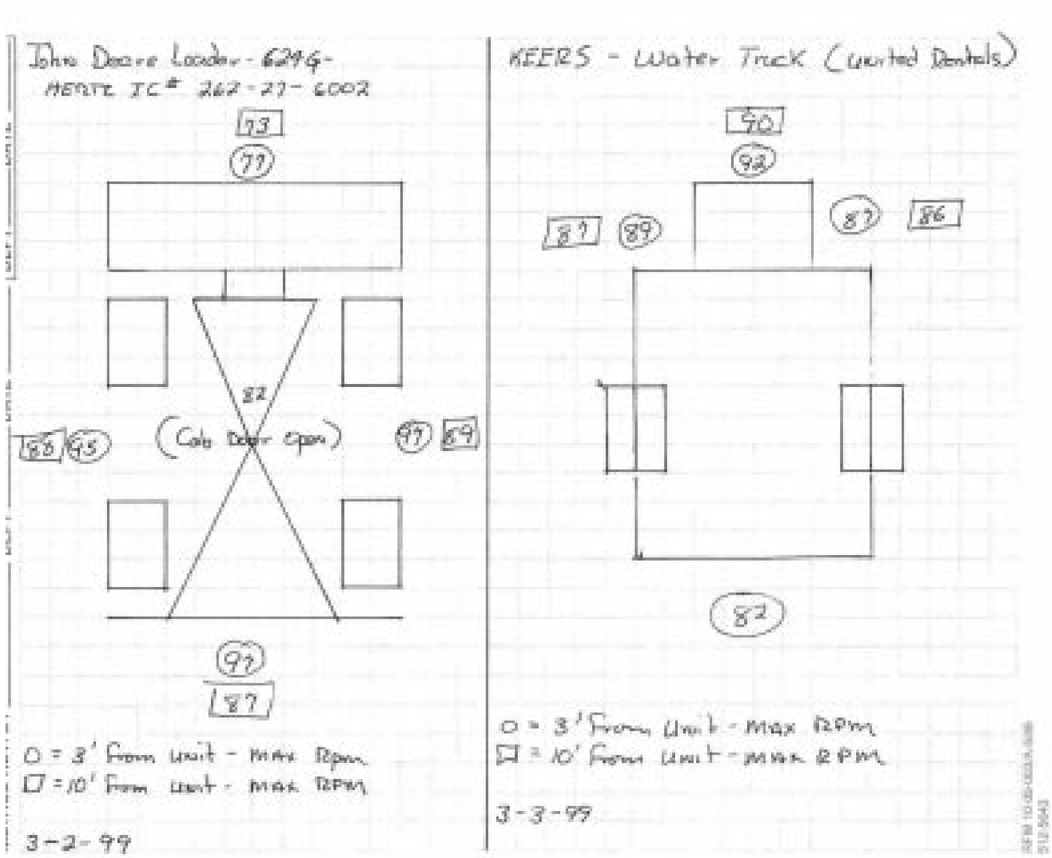
1-27-99

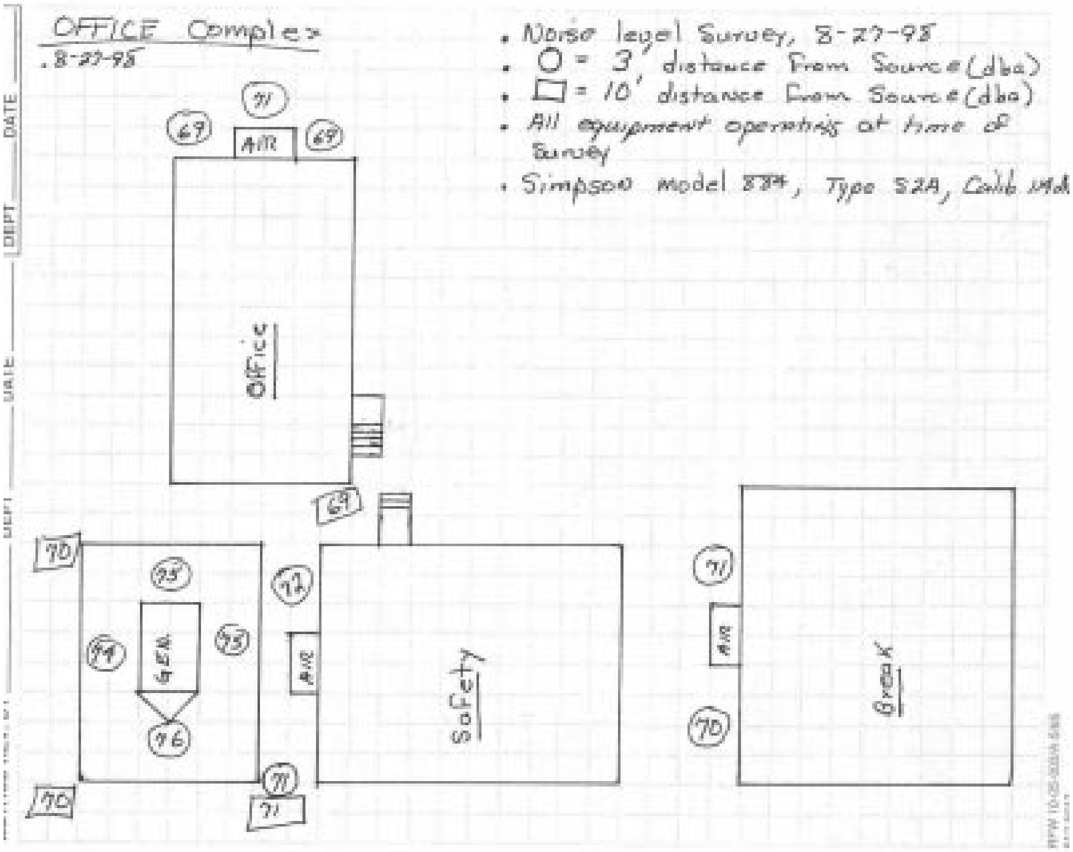
METHOD REV. BY ____ DEPT ____ DATE ____ DEPT ____ DATE ____


Compacter
5-27-95
Back-up alarm 100 dba @ 10' max idle/vibrator
O = 3' - Idle
□ = 3' - max RPM
Δ = 3' - vibrator on
KEERS DUMP TRUCK
5-27-95
Reverse Alarm: 92 @ 10' @ max idle.
O = 3' - Idle
KEERS TRAILER
Air Compressor
O = 3' - Idle
□ = 3' - max RPM
Water TRUCK
Reverse alarm: 86 @ 10' @ max Idle w/ Pump on.
O = 3' - Idle
□ = 3' - Pump on
Δ = 10' - Pump on
9-15-95

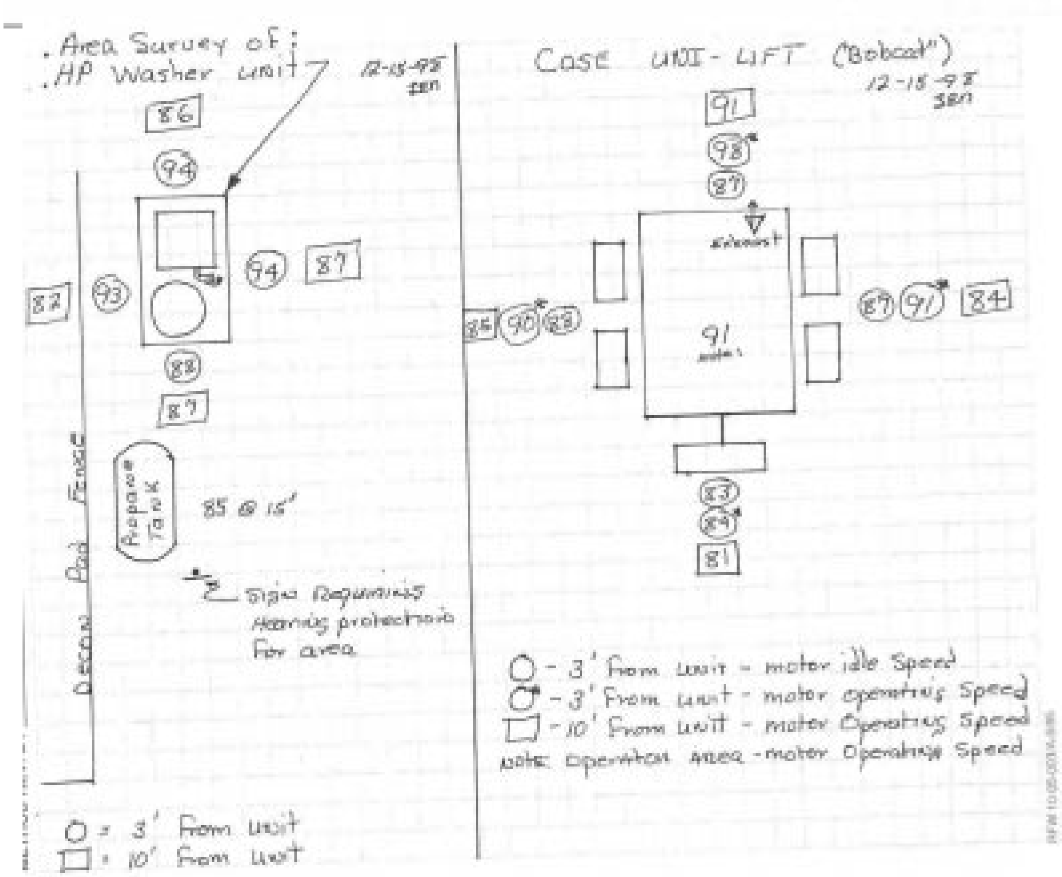

KEERS - Tracked Loader
96
* Lever door slam + 115-120 dba w/o rubber cushion. 60-70 dba
O = 3' from Unit (dba)
□ = 10' from Unit (dba)
1-27-99
HERTZ Freightliner
75-80 Loaded-driving
75-78 unloaded
85-90 metal/metal dumping
90-95 door slam.
1-27-99
* KEERS will extend exhaust 2' higher so exit above Cab level.


WATER TANK/Trailer — KEERS #148195
87
83
84
86 99
96 88
97
87
O = 3 ft from unit (dBA)
□ = 10 ft from unit (dBA)
10-26-98
Gorman Rupp Pump
87
96
86 97
exhaust
96 87
94
86
O = 3 ft from unit (dBA)
□ = 10 ft from unit (dBA)
11-2-98


John Deere Loader - 624G -
HERTZ IC# 262-27-6002
73
77
82
(Cab Door open)
88 95
97 89
97
87
O = 3' from unit - max Rpm
□ = 10' from unit - max RPM
3-2-99
KEERS - Water Truck (United Rentals)
90
92
87 89
87 86
82
O = 3' from unit - max RPM
□ = 10' from unit - max RPM
3-3-99



OFFICE Complex
8-27-98
Noise level Survey, 8-27-98
○ = 3' distance from Source (dba)
□ = 10' distance from Source (dba)
All equipment operating at time of Survey
Simpson model 884, Type S2A, Calib mode
Office
AIR
Safety
Break
GEN
71
69
69
69
70
95
94
93
96
70
72
71
71
71
70



Area Survey of:
HP Washer unit
12-15-98
Case UNI-LIFT ("Bobcat")
12-15-98
86
94
94
87
82
93
88
87
Propane Tank
85 @ 15'
Sign Requiring Hearing protection for area
Decon Pad Fence
○ = 3' from unit
□ = 10' from unit
91
93
87
exhaust
91
89
91
84
85
90
88
83
89
81
○ - 3' from unit - motor idle Speed
○* - 3' from unit - motor operating Speed
□ - 10' from unit - motor operating Speed
note: operation area - motor operating Speed

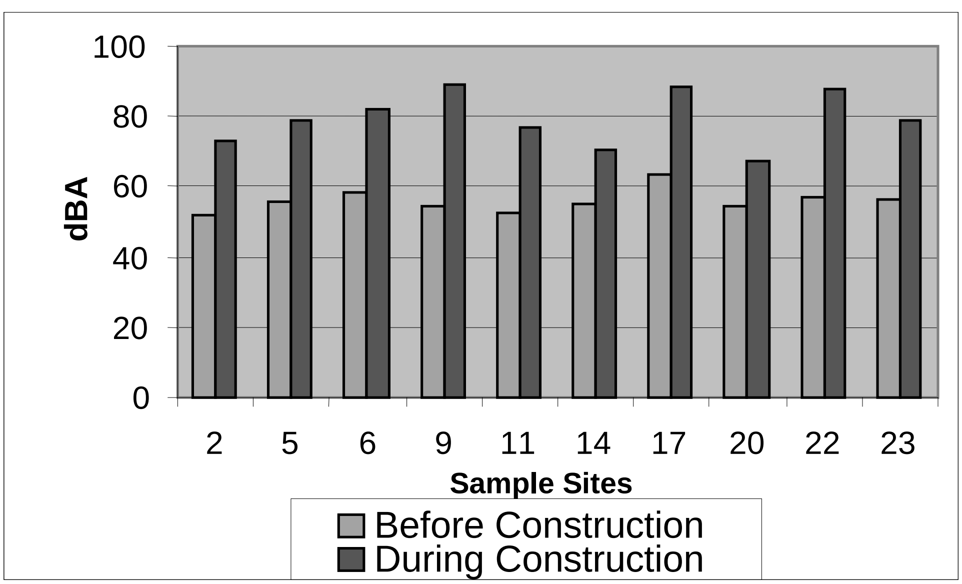
APPENDIX C

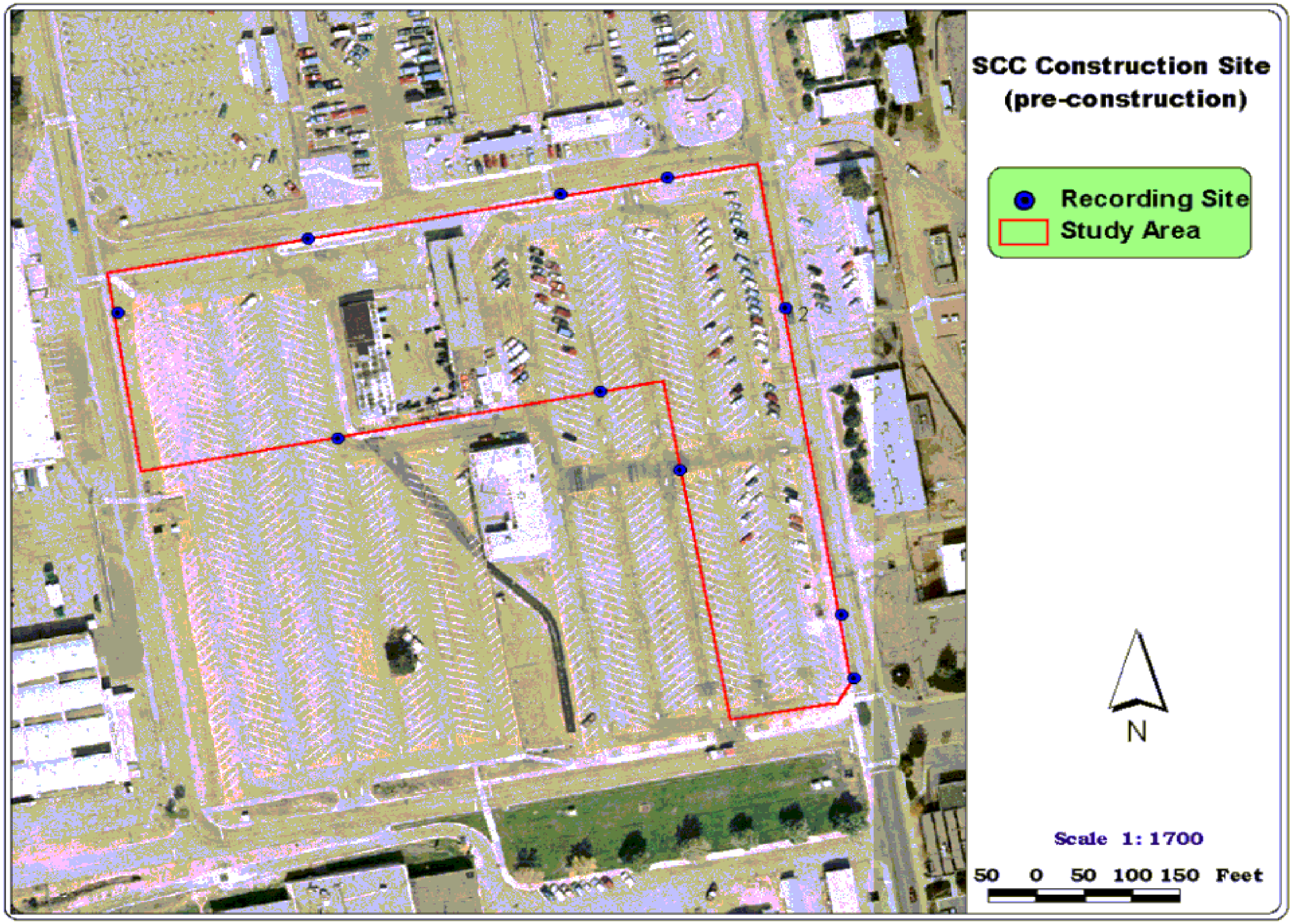
In October of 1999 Hensel Phelps Construction Company began the first phase of construction on the Strategic Computing Complex (SCC) at LANL. Secretary of Energy Bill Richardson stated, “The SCC will allow us to continue the pursuit of cutting-edge large-scale computing in the national interest into the 21st century.” Since we knew when construction would begin, we saw an opportunity to compare pre construction and during construction sound levels.

A fence was installed around a large parking lot in TA-3 east of building SM-38, Johnson Controls Incorporated, which controls access to the construction area. The area of the parking lot outside the fence was still used during construction. We measured the length of the fencing and randomly selected and labeled ten points along the outer perimeter of the fence as our sampling sites as seen in the study area diagram that follows. Before construction began we sampled the sound level at each site with each sample consisting of one hour of data.

After construction began we took sound level data in the same manner at all ten sites. We also recorded the source of noise. The equipment in operation during recording were as follows: Cat 938G front-end loader, Rust 325B track loader, and a Ford L9000 dump truck. The equipment was in motion during all the measurements, therefore our distance measurements were inaccurate because they were taken only at the beginning of the study. However, distances varied from 50 to 350 feet. The equipment used for measuring the sound level is identical to the equipment we used in the previous study. All measurements were taken on a weekday between 8:30 a.m. and 5:00 p.m.

We ran a paired t-test on Statistix (1998). The results indicated that noise levels before and during construction were significantly different at $P < 0.01$. By converting the dB(A) values into pressure, taking an average, and converting back to dB(A) we were able to determine average sound levels for our pre construction set of measurements and also for our construction noise measurements. This was necessary because of the fact that the decibel scale is logarithmic. The average sound level before construction began was 56.5 dB(A) and the average during construction was 82.1 dB(A), a difference of 25.6 dB(A). The data are reported beginning with site 2 (see diagram) and continuing clockwise around the perimeter of the fence as seen in the diagram. The following graph compares sound levels at each sample site before and during construction.




SCC Construction Site
(pre-construction)
Recording Site
Study Area
2
N
Scale 1: 1700
50 0 50 100 150 Feet